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Agroforestry: Improving environmental health

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In this era of global warming, fast degradation of land productivity and other environmental hazards, agroforestry is indeed a stake for natural resources and socio-economic sustainability. Agroforestry is found to be the most desirable strategy for maintaining social, economic and ecological sustainability in India. Agroforestry is a collective name for land-use systems involving trees combined with agricultural crops, grasses and/or animals on the same unit of land. It produces multiple outputs, thus emphasis should be laid on the use of multiple trees and shrubs.

During the last five decades, since independence, much of the emphasis was laid towards the physical accessibility of food. By the end of the 21st century, ecological access to food might become the most important challenge raising threats towards the existence of mankind. India is one the major populated countries in the world with a biodiversity of 5% which is about 2.4% of the global land area.

This is not a matter of rejoice as deforestation is also taking place at a rate of 1.5 million ha every year. Due to this, serious genetic erosion of wide varieties of flora and fauna is taking place. In addition, extensive and intensive cultivation of crops also resulted in degradation of biodiversity. Here, agroforestry emerged as a soul of biodiversity conservation. Agroforestry implies co-existence of farm and forests which can achieve both natural resources and socio-economic sustainability.

Agroforestry and its benefits to farmers

Agricultural lands in hilly regions of India especially Jammu and Kashmir are suffering a lot of depletion due to landslides, changes in precipitation patterns, runoff, drying up of natural springs and lack of irrigation facilities which results in uneconomical agriculture. Such deficiencies could be easily overcome by Agroforestry practices.

Under this system, trees serve as wind breaks, shade providers and soil binders besides generating additional income. In Himalayan regions, fodder for the livestock comes from forests and grasslands. But grazing in grasslands and lopping in forests has almost been banned by the Government as alpine meadows and grasslands are declared as protected areas. In this case, Agroforestry serves the purpose. It provides the farmer with timber, fuelwood and fodder for the cattle.

Agroforestry products such as timber, fruit, food, fiber, fodder, medicine and others are progressively meeting the subsistence needs of households and providing the platform for greater and sustained productivity.

Thus, agroforestry systems offer opportunities to farmers for diversifying their income and to increase farm production. Research results from different agro climatic regions of the country show that financial returns generated from agroforestry systems vary greatly but are generally much higher than returns from continuous unfertilized food crops. The higher returns associated with agroforestry can translate into improved household nutrition and health, particularly when women control the income.

Agroforestry and ecosystem services

Agroforestry has the potential to provide most or all the ecosystem services. Agroforestry systems, and in general, trees on farms, and trees outside the forest (De Foresta et al. 2013) can be a good alternative for achieving sustainable and climate-smart agriculture. The introduction of trees in the agricultural landscapes often improves the productivity of farms while providing opportunities to create carbon sinks. Agroforestry systems provide suitable ways to reduce CO2 (major Green house gas) emissions in the atmosphere.

Agroforestry land use increases livelihood security and reduces vulnerability to climate and environmental change. There are ample evidences to show that the overall (biomass) productivity, soil fertility improvement, soil conservation, nutrient cycling, microclimate improvement, and carbon sequestration potential of an agroforestry system is generally greater than that of an annual system (Dhyani et al., 2009a). Agroforestry has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risks. It also provides for ecosystem services - water, soil health and biodiversity (NRCAF, 2013b).

Agroforestry and biodiversity conservation

Agroforestry innovations contribute to bio-diversity conservation through integrated conservation development approach. Forest degradation has caused immense losses to the bio-diversity, which can be conserved through agroforestry by adopting a strategy of conservation through use. It improves micro-climate of the area by lowering soil temperature, reduction in evaporation and maintenance of soil moisture.

The biodiversity shall help in the development or improvement of new varieties or populations. It will further help in enhancing the availability of improved planting material, which is a key to the increase in productivity and production at farm level. Swaminathan (1983) has pointed out that biodiversity is the feed stock for a climate resilient agriculture. Agroforestry with components like trees, agricultural crops, grasses, livestock, etc. provides all kinds of life support system.

Agroforestry and employment opportunities

Agroforestry systems due to diverse options and products provide opportunities for employment generation in rural areas. Increased supply of wood in the market has triggered

a substantial increase in the number of small-scale industries dealing with wood and wood based products in the near past. Such industries have promoted agroforestry and contributed significantly to increasing area under farm forestry.

Recognizing agroforestry as a viable venture, many business corporations, limited companies such as ITC, WIMCO, West Coast Paper Mills Ltd., Hindustan paper Mills Ltd., financial institutes such as IFFCO have entered into the business and initiated agroforestry activities in collaboration with farmers on a large scale. Besides the existing agroforestry practices, there is a tremendous potential for employment generation with improved agroforestry systems to the tune of 943 million person days annually.

Agroforestry has shown its potential as a key path to prosperity for millions of farm families, leading to extra income, employment generation, greater food and nutritional security and meeting other basic human needs in a sustainable manner.

As mitigation strategy to climate change as well as rehabilitation of degraded land, the conversion of unproductive grasslands and crop land to agroforestry is a major opportunity as it helps for carbon sequestration and makes land productive and reduces further soil degradation. By virtue of diversity of the components of the agroforestry systems like food grains, vegetables, fruits, nutritional security to the communities could be ensured. Induction of fodder cultivation under agroforestry land use will ensure production of milk, meat and animal products and also wide range of food crops, pulses and oil seeds can meet diverse needs of society.

On the whole, in addition to promoting indigenous agroforestry models, it appears that a great deal of research needs to be done to identify short rotation, high value species which suit the farmers' requirement of planting on marginal lands. It would probably be more realistic to select trees that could provide more cash benefit to farmers through their products, and to accept that in the longer term they will also provide environmental benefits arising from a more complex agro- ecosystem.

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